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High Precision Traffic Monitoring Alert System using Image Background Subtraction

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Abstract

Objective: Monitoring the road traffic is helpful to know about the traffic density of a particular location, which helps in redirecting the traffic when crowded. In this paper, traffic density is monitored and vehicle count is estimated using background subtraction algorithm. **Methods:** The proposed technique utilizes a novel Motion Detection and Running Gaussian Average (MDRGA) recursive technique. The frame is captured from the input video sequence and is transformed to 0 to 255 gray levels from RGB color mode. This conversion considers the RGB values for each pixel and yield the corresponding reflectance value proportional to the brightness percentage of that pixel. The edge detection is then performed on the gray converted by locating the pixels of the image that correspond to the edges. **Findings:** The proposed system detects motion by comparing sequential frames crossing an imaginary line marked in the reference frame. Thus, the traffic density is detected and the proposed method is found to be efficient in terms of cost, quality and accuracy. This algorithm fetches the input video quickly from camera or storage device, processes immediately and gives the count of vehicles. This proposed system avoids occlusion problems and gives better results. **Applications/ Improvements:** This algorithm is helpful to avoid traffic collisions at peak areas, to avoid accidents and to reach the destination on time. Thus, the proposed system finds its application in real time systems and provides risk free environment.

Keywords: Background Subtraction, Motion Detection and Running Gaussian Average (MDRGA) Recursive Technique, Redirection, Vehicle Count

1. Introduction

Checking the street traffic is useful to think about the vehicle density in the particular area. Hence by knowing the density of vehicles on a specific area, redirection can be taken. This information is used to avoid traffic jams at peak hours, to avoid accidents and to take redirection. This monitoring is helpful for recognizing basic stream period of time or else deciding this impact of vehicles or people on foot or vehicular traffic stream. This valuable data can encourage for better activity administrations, for example, timings can be changed in traffic lights in view of traffic stream to reduce the traffic and to avoid accidents. In the existing method and all, occlusion problems were there and the vehicle counts were not so accurate and successful. Illumination and environmental changing problem was there under dark background conditions. In this paper, road side vehicles are monitored and its counts are estimated using background subtraction algorithms. Here Motion Detection and Running Gaussian Average (MDRGA) Recursive Technique is used which reduces the illumination changes greatly and fetching the video for counting is done soon which is suitable for real time environment. Section 2 proposes fetching and processing of video. Section 3 proposes, hardware and simulation output has added. In the 4th part, a graphical comparison of existing and proposed methods has added.

Robust and computationally light weight algorithm along with smart cameras are used for counting the vehicles and detecting taillights of vehicle and alert signals

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which reduces the collision and smart standalone cameras of low consumption power is used along with codebook for robustness[1]. Vehicle classification has been proposed with image processing and Kalman filter principles using software techniques which is cost effective and Test error for classification and identification are 5% and 4%[2]. Based on WSN, classification and counting of vehicles are done which aimed to reduce power consumption[3]. When multiple targets are recorded, it's difficult to find out and process a particular image and moreover implementing this in a large scale is a challenge here[3]. Analysis and processing of video signals has proposed based on raspberry pi which aimed for reliability and low power consumption[4]. In Real time Highway traffic Surveillance System (RHSS), density of vehicles, its speed and counting were analyzed using 3 D Hungarian algorithm along with Kalman Filter[5]. Memory consumption is the major drawback[5]. Edge detection and emergency vehicle identification had proposed[6]. Which is based on image processing which in turn eliminates the need of using hardware components such as RFIDs and sound sensors that reduces the cost considerably. Edge identification of roads and automatic imaginary extension of roads can be done by fuzzy connectedness logic for the extraction of road from remote sensing objects or images[7]. Abnormal situations in road such as illegal or rash driving, traffic congestions and accidents can be identified through this video analysis method[8]. Removal of shadow on roadside vehicles to give the exact count of vehicles is done and the drawback is it needs appropriate threshold value since it creates a greater impact on algorithm when the value is extracted by sobel method of edge detection[9]. Here objects are identified using object segmentation with edge detection[10]. The Blob analysis here[10] is to identify the vehicle type along with vehicle speed calculation. Further counting the number of objects can be done using Motion History Images (MHI) that generates object's history and label has assigns to each object and then helps the travelers to reach their destination by let them know the unknown paths[10,11].

2. Proposed System

Real time video streams are being recorded by a camera module and send to the MATLAB for further processing Figure 1. Video processing is done in MATLAB in which videos are taken as frames. It assigns the background image as the reference image. Road without vehicles is taken as background image at regular intervals and it is reestablished periodically for better accuracy. Road with vehicles are take as foreground image. That foreground images are successively obtained as frames from a video stream. Then background subtraction takes place by differencing a foreground image from the background image. This background subtraction is done by shadowing the part of a foreground image which has similarities with the background image. This shadowing can be done easily by RGB to gray conversion. Motion Detection and Running Gaussian Average (MDRGA) Recursive Techniques Algorithm is used here which reduces the memory consumption and speeds the process which is very suitable for deploying in real time. Then these video streams can either be saved in a storage module such as SD card or can be fetched later or directly send to a microcontroller. The background subtraction phase is done in simulation part by MATLAB. Thus vehicle counts can be estimated from the foreground image. The decision making phase is done in microcontroller. The microcontroller has to be programmed in such a way that it shows "Traffic density is high" in the event that the quantity of vehicles is high in a specific timeframe and "Traffic is normal" for the rest of the cases. Then finally the status of the road about its traffic density is displayed in a LCD display.

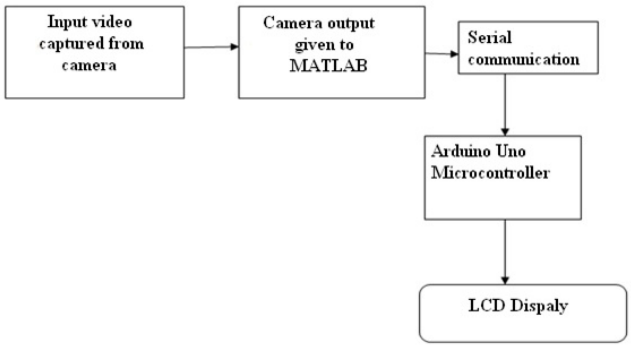

Figure 1. Block diagram of proposed work.

2.1 Video Processing

Video preparing is a subcategory of Digital Signal Processing strategies where the information and yield signs are video streams. In PCs, one of the most ideal approaches to achieve video examination objectives is

utilizing picture handling techniques as a part of every video outline. For this situation, movements are just acknowledged by looking at successive edges. Video handling incorporates pre-channels, which can bring about complexity changes and clamor disposal alongside video outlines pixel size transformations. Highlighting specific regions of recordings, erasing unsatisfactory lighting impacts, dispensing with camera movements and expelling edge-antiques are performable utilizing video handling strategies.

2.2 RGB to Grayscale Conversion

In video examination, changing over RGB shading picture to grayscale model is finished by picture handling strategies. The fundamental objective of this change is that handling the grayscale pictures can give more adequate results in contrast with the first RGB pictures. In video preparing methods the arrangement of caught video edges ought to be changed from RGB shading mode to a 0 to 255 dark level. While changing over a RGB picture to a grayscale mode, the RGB values for every pixel ought to be taken and a solitary worth mirroring the shine rate of that pixel ought to be set up as a yield. The grayscale conversion is given by,

$$Y = (0.299 * RC) + (0.587 * GC) + (0.114 * BC) \quad (1)$$

where, RC – Red Color, GC – Green Color and BC – Blue Color.

Grayscale conversion using average method is given by,

$$\text{Grayscale conversion} = (\text{Red Color} + \text{Green color} + \text{Blue color} / 3) \quad (2)$$

2.3 Edge Detection

Object location can be performed utilizing picture coordinating capacities and edge recognition. Edges are focuses in computerized pictures at which picture brilliance or dark levels changes all of a sudden in sum. The fundamental errand of edge recognition is finding all pixels of the picture that compare to the edges of the articles found in the picture. The general expression to describe a single image pixel processing for a whole image array is given by,

$$M(a, b) = K \bullet [L(a, b)] \quad (3)$$

where, L(a, b) represents the input image pixel at coordinate location (a, b), M(a ,b) is the output image pixel having the same coordinates and K is a linear mapping function.

2.4 Counting

The proposed system detects motion by comparing sequence of frames whenever a vehicle crossing an imaginary line marked in the reference frame. Thus, the traffic density is detected and the proposed method is found to be adaptable in real time environment.

3. Results and Analysis

This method has been implemented in both hardware and simulation. Simulation part is done by using MATLAB in which Motion Detection and Running Gaussian Average (MDRGA) Recursive Technique is used. Here the original video is converted into grey scale and then background subtraction is performed Figure 2. From the subtraction method, objects in the foreground are found out and then an imaginary line has fixed Figure 3. When a vehicle passes that imaginary line each and every time, vehicle count is estimated Figure 4. In Hardware implementation, video sequences are directly obtained from web camera and then the input video is feed to the controller (ATMEGA 328) in Arduino uno R3 board Figure 5 for further processing. Then the vehicle count results after processing can be viewed in a LCD display. If the camera senses more vehicles at a time, then it shows "TRAFFIC HIGH" in the LCD display or else counting will be automatically going on.

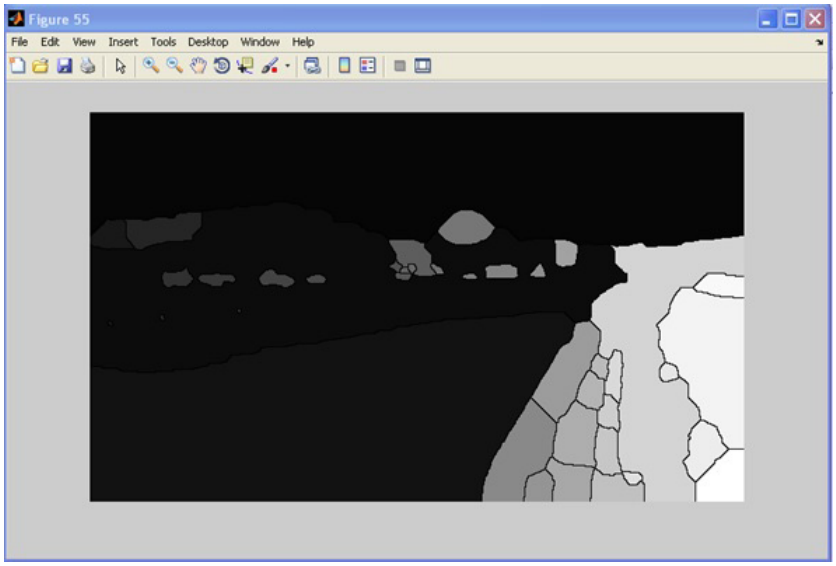

Figure 2. Background updating and differencing.

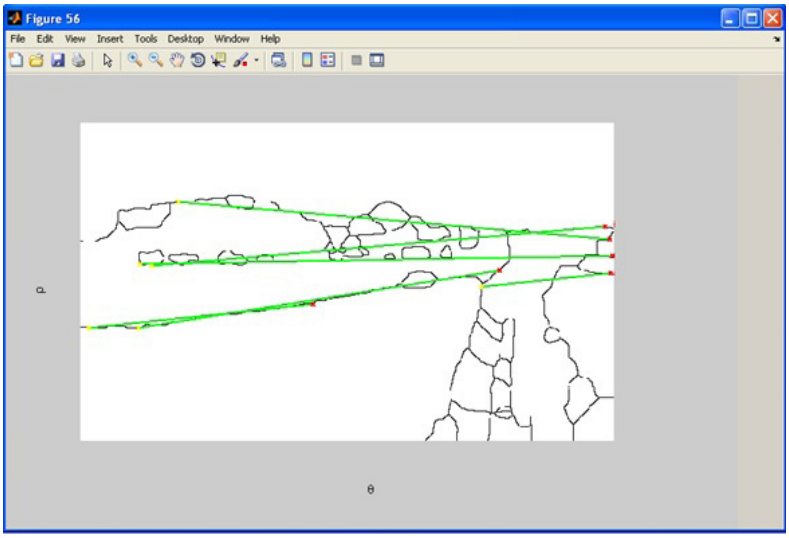

Figure 3. Blob detection.

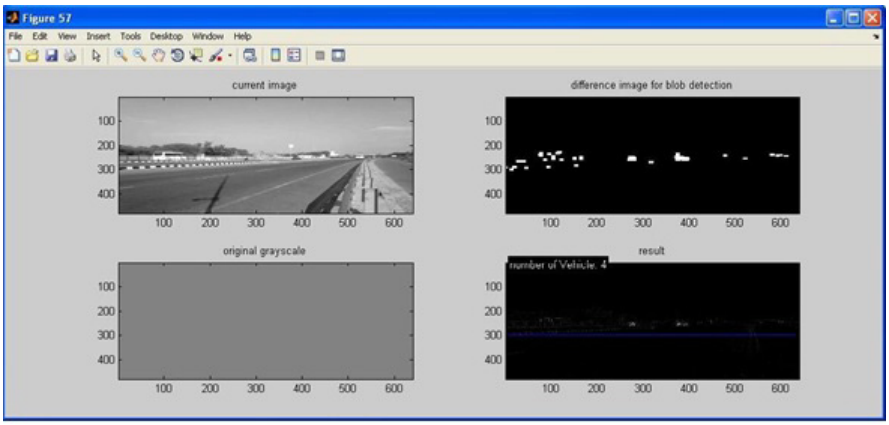

Figure 4. Final image processing result which gives vehicle counts.

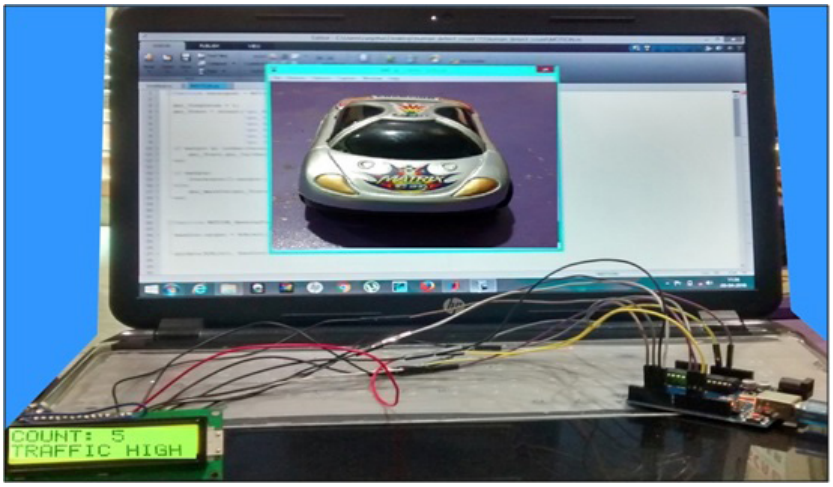

Figure 5. Vehicle count using Arduino uno board.

4. Experimental Results

The consequences of the different techniques are exhibited. Estimation of vehicle counts were done by different methods i.e, counting was done manually, by using sensors and then image processing algorithm over a particular period of time. In Figure 6 it is experimentally found that counting of vehicles using image processing algorithm has much greater accuracy and it counts more number of vehicles without delay or malfunctioning.

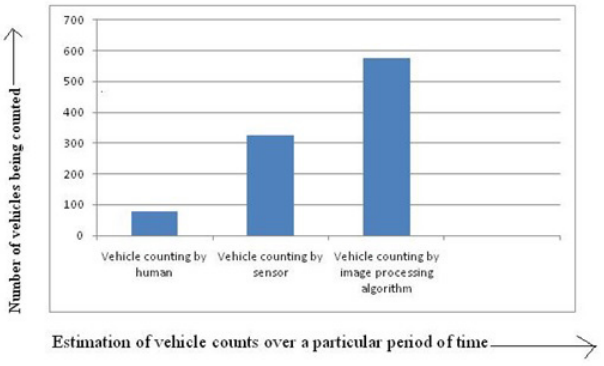

Figure 6. Comparison between existing and proposed work.

5. Conclusion

In this paper a vehicle checking strategy taking into account picture preparing calculations and controller has been exhibited. This strategy diminishes the cost due to being mostly programming based arrangement. Other than it has quality and precision. Test results demonstrated that introduced strategy worked adequately. Video signal preparing and examination were proposed with the emphasis on low power utilization and dependability of the framework. This is still a long way from being last form of activity checking framework and there is parcel for us to make strides. In future, further examinations including speed assessment and testing sensor hub in various climate conditions can be executed as an upgrade of this anticipate.

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